VERIFICATION OF TRANSLATION

GERMAN PATENT APPLICATION NO. 103 37 475.2

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Date September 2, 2010

Adjustable Mechanism for a Motor Vehicle

Description

The invention relates to an adjustable mechanism for a motor vehicle according to the preamble of claim 1.

An adjustable mechanism of this kind serves for adjusting an adjustable part in a motor vehicle, more particularly a seat part, and comprises a spindle nut (able to rotate about its longitudinal axis), which has on the one side internal toothing through which it interacts with a (preferably fixed, i.e. rotationally secured) spindle and which has on the other side an external toothing through which it engages with a further gearing element, more particularly a drive worm. The external toothing of the spindle nut thereby extends over its outer surface (circumferential face).

According to a preferred use this gearing can serve to move one seat part relative to another seat part, by way of example to move a first rail of a rail longitudinal guide, on which is fixed a motor vehicle seat which is adjustable in the seat longitudinal direction, relative to a second rail of the rail longitudinal guide, which is to be fixed on a floor assembly of the corresponding motor vehicle. The fixed spindle herein is fixed on one of the vehicle parts which are displaceable relative to each other, and the spindle nut together with the further gearing element and associated drive device (e.g. drive motor) are mounted on the other vehicle part. If in an arrangement of this kind the spindle nut is turned by means of the drive worm which is drivable through the drive device, it is hereby moved in the longitudinal direction along the fixed spindle, leading to the desired relative movement of the two vehicle parts.

Adjustable mechanisms of this kind are required in increasingly large numbers in motor vehicles in order to be able to adjust the position of seat parts and other vehicle parts, such as e.g. arm rests on the door side, centre console etc. and to adapt them to the requirements of different vehicle occupants.

The object of the invention is therefore to provide an adjustable mechanism of the type mentioned at the beginning which with a compact structure also has good stability whilst using materials as light as possible.

This is achieved according to the invention by providing an adjustable mechanism with the features of claim 1.

According to this the external toothing of the spindle nut extends in the axial direction only over a part of the axial extension of the outer surface of the spindle nut 1, and it is formed by radially inwardly pointing recesses in the external surface of the spindle nut, wherein the spindle nut has in the axial direction beyond the external toothing at least one ring-shaped (cylindrical) end section with a defined diameter (which is not provided with an external toothing).
An increased stability in the spindle nut is hereby reached. This is particularly important since on an adjustable mechanism of a motor vehicle, more particularly when using this adjustable mechanism for adjusting a seat part, in a crash situation considerable forces can occur, which must not lead to the spindle nut slipping through on the associated spindle.

In particular notch tension effects caused by the external toothing are prevented which in a crash situation led to an increased risk of breakage.

If the spindle nut has only one axial end section which does not have external toothing, this is preferably adjoined (in the axial direction) by that end of the external toothing on which the highest mechanical strain is to be expected in a typical crash situation.

The solution according to the invention is carried out in a specific embodiment in that the spindle nut is formed at each of its axial end sections (either side of the external toothing) without toothing and forms there a cylindrical face with defined diameter. Between these two end sections of the spindle nut extends the external toothing which is formed – in relation to the diameter of the tooth-free end sections – by radially inwardly pointing recesses. This means that the external toothing, viewed radially, does not project beyond at least one tooth-free end section of the spindle nut. Expressed in other words, the maximum radial distance of the external toothing from the longitudinal axis (centre or rotational axis) of the spindle nut is less than or possibly equal to the radius of the tooth-free end sections of the spindle nut.

To increase the supporting diameter when interacting with the other gearing element the external toothing of the spindle nut is preferably made more like a worm wheel toothing, thus formed substantially as globoid toothing. However a cylindrical part in the tooth path – viewed in the axial direction of the spindle nut – is designed in the centre region of the toothing for example with an involute profile in order to widen the tolerance position of the other gearing element (more particularly in the form of a worm) axially relative to the spindle nut and to thereby eliminate noise problems.

The external toothing of the spindle nut is thus more particularly globoid in shape at its axial edges. It has a continuous transition from the cylindrical part into the tooth-free axial end sections of the spindle nut. This continuous transition from the cylindrical part of the external toothing to the relevant tooth-free axial end section is reached through a constant (continuous) reduction in the tooth height in the radial direction.
The measures described above which with a predetermined best possible compact design of the spindle nut also ensure a particular stability enable the spindle nut to be made (by injection moulding) from plastics, e.g. PA, POM or PEEK.

In order to increase the bearing capacity of the internal toothing (in the form of an internal thread) of the spindle nut this extends axially over a greater length than the external toothing. The internal toothing thereby extends preferably into the two end sections (tooth-free round their outer circumference) of the spindle nut.

The bearing capacity of the internal toothing (in the form of an internal thread) of the spindle nut is increased in that the tooth thickness of the tooth elements of the internal toothing is greater than the gap width of the internal toothing, namely preferably twice as big or even more than twice as big. The term “toothing” is thereby to have a general meaning here so that the term “internal toothing” of the spindle nut embraces in particular an internal thread through which the spindle nut interacts with a spindle.

The spindle nut and the further gearing element, more particularly in the form of a worm, which interacts with its external toothing, are preferably mounted in a gearbox housing which consists of plates which fit together through push-fit connections, namely preferably of two pairs of opposing housing parts, more particularly in the form of plates. According to a preferred variation two housing parts of U-shaped cross-section are provided whose two end sides (each formed by the arms of the U-section housing parts) are fitted with additional bearing plates which serve to support the two axial ends of the spindle nut. This can be provided at each axial end with a bearing collar for this purpose.

Alternatively the two end sections of the spindle nut can also serve directly to mount the spindle nut in the gearbox housing. In the latter case the additional bearing plates of the gearbox housing can be omitted and the two U-shaped housing plates can be used directly for supporting the spindle nut.

For a lightweight construction of the adjustable mechanism the gearbox housing is also made from plastics, wherein the plastics used for the bearing plates is for optimising the friction pairing matched with the plastics used for the bearing collar of the spindle nut. Furthermore a heat-dissipating plastics or metal material is preferably used for the end bearing points (bearing plates) or for the housing as a whole.

According to a preferred embodiment of the invention the bearing openings provided in the bearing plates for the spindle nut each have an edge protruding from the relevant bearing plate in order to enlarge the bearing surface area. This is flanged by the two U-shaped housing halves of the gearbox housing for stability.

In a preferred embodiment the gearbox housing has in at least one side boundary wall a recess in which the spindle nut, or the other gearing element interacting with the external toothing thereof, radially engages. This recess can be on the one hand a (window-shaped) opening in the corresponding boundary wall or merely an indentation. The spindle nut is thereby preferably assigned two recesses in opposing boundary walls whilst the other gearing element is assigned one recess on the side opposite the spindle nut.

It is important that these recesses are arranged radially relative to the relevant gear element (spindle nut or worm), thus are spaced apart in the radial direction from the rotational axis of the relevant gearing element (spindle nut or worm). They are thus not bearing openings into which the gear elements axially engage but recesses into which the gear elements project radially by their toothed regions, without being mounted therein. The structural space required for the adjustable mechanism is hereby further minimised. With the design of the recesses as openings in the relevant boundary wall it is possible to reduce the noise developing during operation still further by avoiding resonance.

On the housing plates furthermore resilient elements can be mounted which, when using a multi-component injection moulding process, can be made from a different plastics than

the housing plates themselves in order to provide acoustic decoupling between the gearbox housing and the associated vehicle part.

With a suitable sliding pairing as regards the bearing of the spindle nut on the gearbox housing it is possible to omit completely spacer discs for supporting the spindle nut. Where necessary steel discs are preferably used as the spacer discs which are characterised by good heat dissipation and low friction value.

According to a preferred further development of the invention the housing parts are connected to one another more particularly in the region of their push-fit connections (additionally) through laser welding. The material of the outer U-shaped housing plates is herein preferably transparent for the laser beam used for the welding and the material of the inner bearing plates of the gearbox housing is non-transparent (e.g. by adding carbon black) in respect of the laser beam so that a connection with the outer U-shaped housing plates can be produced by partially melting the inner bearing plates.

The gearbox housing is preferably set in a holder of U-shaped cross-section from the side arms of which project fixing flanges which serve to fix the holder (together with the gearbox housing) on the associated vehicle part, e.g. seat rail.

A method for manufacturing an adjustable mechanism according to the invention with a spindle nut consisting of plastics and a plastics gearbox housing which comprises bearing plates for the spindle nut, is characterised according to claim 31 in that the spindle nut and at least the bearing plates are made by injection moulding in one and the same tool (in a multi-stage injection moulding process), namely preferably one after the other in two successive injection processes. The spindle nut is hereby already mounted at the end of the injection moulding process in the associated bearing points of the bearing plates of the gearbox housing. It is not necessary to then introduce the spindle nut at a later stage into the bearing points (more particularly bearing openings).

According to a variation of the method according to the invention the other gearing element (thus in particular a worm) is then placed in the tool and the two U-shaped housing halves of the gearbox housing are then also made in the same injection moulding tool.

Alternatively the worm can however also be subsequently clipped into the housing after the spindle nut and gearbox housing have been made in one injection moulding tool.

With the common injection moulding of all the housing plates in one injection moulding tool the housing plates are themselves already connected to one another during production so that no subsequent fitting together of the housing plates is required.

As an alternative however the individual housing plates can also be made separately and then fitted together. The push-fit connections are then fixed against one another by shaping round, sticking or thermal processes such as laser welding, ultrasound welding or hot caulking.

If the housing plates of the gearbox housing are connected to one another through laser welding, more particularly in the region of the push-fit connections, axial bearing play between the inner housing plates (bearing plates) of the gearbox housing and spindle nut is removed (forced out) before or during the welding process. For this a defined axially acting force is applied to the inner housing plates (bearing plates), then those areas of the inner housing plates (bearing plates) which serve to form a push fit connection with the outer U-shaped housing plates are melted through lasers, wherein the welding process is completed when a suitable force-path measurement shows that the inner bearing plates bear against the corresponding end sections of the spindle nut.

In order to enable an axial play compensation of this kind the push-fit connections are designed with axial play between the inner bearing plates and the outer U-shaped housing plates. During laser welding of the bearing plates a molten mass is formed which fills out the play-conditioned gaps and bonds with the surface of the other U-shaped outer housing plate.

Further features and advantages of the invention will now be apparent from the following description of embodiments illustrated in the drawings.

Herein:

Figure 1a	shows an exploded view of an adjustable mechanism for a motor vehicle with gearbox housing;
Figure 1b	shows the adjustable mechanism of Figure 1a in the assembled state;

Figure 1c shows the adjustable mechanism of Figure 1a in the assembled state, partially broken up;

Figure 2 shows the adjustable mechanism of Figures 1a to 1c with an additional gearing element in the form of a spindle and with a holder;

Figure 3 a preferred embodiment of the engaging threads of the spindle of Figure 2 on the one hand and the spindle of the adjustable mechanism on the other.

The adjustable mechanism for a motor vehicle illustrated in Figures 1a to 1c and 2, more particularly for adjusting the seat longitudinal position of a motor vehicle seat by means of a longitudinal guide rail, comprises a fixed (rotationally secured) threaded spindle 100, a spindle nut 1 mounted rotatable thereon and a drive worm 2 driving the spindle nut. The spindle nut 1 and the drive worm 2 are mounted in a gearbox housing 3,4.

To use this gearing in a seat longitudinal adjuster which comprises two guide rails which engage in one another and are displaceable relative to each other, the fixed threaded spindle 100 is fixed on one of the two guide rails and the gearbox housing 3, 4 is mounted together with the spindle nut 1 and worm 2 on the other guide rail through a holder 5 and is connected to this guide rail. The drive worm 2 is assigned a drive (not shown in the drawings), e.g. in the form of a drive motor which during actuation triggers a rotational movement of the drive worm 2 which in turn leads to a rotational movement of the spindle nut 1 which engages with the worm toothing 25 through its external toothing 15. As a result of the interaction of the spindle nut 1 with the rotationally secured threaded spindle 100 there is a displacement of the threaded spindle 100 relative to the spindle nut 1 along the longitudinal axis L of the spindle nut 1 and threaded spindle 100. This in turn leads to a relative movement of the two guide rails along the direction L since the one guide rail is assigned to the threaded spindle 100 and the other guide rail to the spindle nut 1 and the longitudinal axis L of the spindle nut 1 and threaded spindle 100 corresponds to the adjusting direction of the guide rails which are displaceable relative to each other.

Adjustable mechanisms of this kind are known for motor vehicle seats. The special features of the adjustable mechanism illustrated in Figures 1a to 1c and Figure 2 will be

explained which result in a particularly compact, lightweight and at the same time stable construction of the adjustable mechanism.

The spindle nut 1 has a cylindrical contour (with an outer surface 10 formed as a cylinder sleeve) into which an external toothing 15 is worked and which is free of toothed areas at each of its two axial end sections 11, 12. The external toothing 15 of the spindle nut 1 is characterised in that compared with the tooth-free axial end sections 11, 12 of the spindle nut 1 it points inwards in the radial direction r (perpendicular to the longitudinal or rotational axis L of the spindle nut 1). This means the extension of the spindle nut 1 in the radial direction r is in the region of the external toothing 15 smaller or in sections in any case at least as large as in the tooth-free end sections 11, 12 which each bear against the external toothing 15 in the axial direction a. As an alternative the spindle nut 1 can also have only one end section without external toothing.

In order to enlarge the support diameter and cross section during interaction of the external toothing 15 of the spindle nut 1 with the worm toothing 25 of the drive worm 2 mounted on a drive shaft 20 , the external toothing 15 of the spindle nut 1 is made like a worm wheel toothing (globoid toothing) which means the external toothing 15 is substantially globoidal. However the centre region 16 of the external toothing 15 in the axial direction a is designed in a cylindrical part in the tooth path with a tooth profile (e.g. in the manner of an involute toothing) in order to widen the tolerance position of the drive worm 2 axially relative to the spindle nut 1 thereby avoiding problems with noise. On either side of the middle area 16 of the external toothing 15, the tooth region of the spindle nut 1 changes continuously into the tooth-free end sections 11, 12 of the spindle nut 1 through a constant radial reduction in the tooth height in the axial edge regions 17, 18 of the external toothing 15.

Overall the design of the outer surface 10 of the spindle nut 1 as described with the inwardly formed external toothing 15 which in the radial direction r does not project over the end sections 11, 12 helps considerably in increasing the stability of the spindle nut 1 which can consequently be made from plastics as a particularly lightweight material.

A special feature lies in the fact that the inner toothing 19 of the spindle nut 1 designed as a thread extends in the axial direction a over a greater length than the external toothing 15 in order to increase the bearing capacity of the thread. The internal toothing 19 (in the form of an inner thread) extends over the entire axial length of the spindle nut 1, thus along the end sections 11, 12 tooth-free on the outer side (and where applicable

also along the relevant bearing collar 13, 14 which does not form a constituent part of the spindle nut in the narrower sense). Furthermore the tooth elements (threaded elements) of the inner toothing 19 (in the form of an internal thread) of the spindle nut 1 have a thickness d (extension in the axial direction a) which is greater than the gap width e, and more particularly at least twice as large, e.g. corresponding to a ratio of 70 : 30. Consequently the tooth elements (threaded elements) of the outer thread 109 of the threaded spindle 100 are considerably thinner than those of the inner toothing 19 (inner thread) of the spindle nut 1. For the thickness of the toothed elements (threaded elements) of the threaded spindle 100 corresponds substantially to the gap width e of the inner toothing 19 of the spindle nut 1.

The spindle nut 1 and associated drive worm 2 are mounted in a gearbox housing 3, 4 which is made of plastics and which is formed from a bearing constituent part 3 with two bearing plates 31, 32 and an outer housing component 4 having two housing plates 41, 42 of substantially U-shaped cross-section.

The two bearing plates 31, 32 which are made of plastics each have a bearing opening 33, 34 as the bearing point for an associated bearing collar 13, 14 of the spindle nut 1 which each protrude on the end side axially away from the spindle nut 1. The two bearing sections 33, 34 are formed by bearing openings and compared with the thickness of the bearing plates 31, 32 have an enlarged extension in the axial direction a in that a corresponding wall section 33a, 34a which engages round the relevant bearing opening 33, 34 protrudes away from and in the axial direction a perpendicular to the relevant bearing plate 31, 32. (An axial clearance of the spindle nut can hereby be minimised by sliding the bearing plates 31, 32 in the axial direction). The plastics for the bearing plates 31, 32 , more particularly their bearing points 33, 34 is selected so that an optimum friction pairing is obtained during interaction with the relevant bearing collar 13, 14 of the spindle 1 which likewise consists of plastics. The associated drive worm however preferably consists of metal.

Furthermore the plastics used for manufacturing the bearing plates 3 or gearbox housing 3, 4 can be heat-conductive so that the heat which arises at the bearing points 33,34 during operation of the adjustable mechanism can be dissipated.

The two outer housing plates 41, 42 of the gearbox housing 3, 4 which are likewise made of plastics are each formed with a U-shaped cross-section with a base surface 410, 420 as well as with side arms 411, 412 and 421, 422 which protrude away therefrom. They

have at the end sides in their arms 411, 412 and 421, 422 recesses 45 which to produce a push-in connection can be pushed (slid) over the end sides 35 of the bearing plates 31, 32. In addition the U-shaped housing plates 41, 42 in the assembled state engage with curved recesses 43, 44 round the bearing sections 33, 34 of the bearing plates 3, 4 and help to stabilise same.

As is clear from Figures 1b and 1c the bearing plates 31, 32 are in the assembled state of the gearbox housing 3, 4 enclosed more or less completely by the U-shaped housing plates 41, 42. To support the drive worm 2 the housing plates 41, 42 have corresponding bearing openings 46.

In a modification of the embodiment described with reference to the figures the spindle nut 1 can also be mounted directly by means of their end sections 11, 12 in the gearbox housing, namely directly in circular arcuate recesses 43, 44 of the U-shaped outer housing plates 41, 42. The inner bearing plates 31, 32 can then be omitted.

Furthermore each of the two housing plates 41, 42 has in its base plate 410 and 420 a recess in the form of a window-like opening 48 in which the spindle nut 1 projects radially by its external toothing 15. The two opposing window-like openings 48 extend parallel to the longitudinal axis L (rotational axis) of the spindle nut 1 and are spaced in the radial direction r from same. They are thus aligned substantially perpendicular to the bearing openings 33, 34 for the spindle nut 1.

In a corresponding way the two U-shaped housing plates 41, 42 in the assembled state form between their arms 411, 412 and 421, 422 a further window-like opening 46 which extends parallel to the axis of rotation (drive shaft 20) of the drive worm 2 and is spaced in the radial direction from same. This enables a radial engagement of the drive worm 2 by its worm toothing 25 in the window-like opening 49 on its side remote from the spindle nut 1.

The window-like openings 48, 49 further improve the compact structure of the adjustable mechanism. For the space for the spindle nut 1 and the drive worm 2 need not be provided entirely inside the gearbox housing 3, 4 but the gear elements 1, 2 can project partially into the side boundary walls (housing plates 41, 42) of the gearbox housing. At the same time this prevents the development of noises inside the gearbox housing as a result of resonances.

Resilient elements, e.g. in the form of injection-moulded uncoupling elements can be provided on the two outer housing plates 41, 42 and where applicable the bearing plates 31, 32 in order to produce an acoustic uncoupling from the vehicle part (e.g. a seat part in the form of a guide rail) on which the gearbox housing 3, 4 is mounted and fixed. These resilient elements (decoupling elements) can when using a multi-component injection moulding process to manufacture the housing parts be made from a different plastics than the housing parts themselves. Alternatively corresponding resilient elements can also be mounted as separate component parts on the gearbox housing 3,4.

To fix the gearbox housing 3, 4 on a motor vehicle part in the form of a guide rail for a motor vehicle seat there is used according to Figure 2 a holder 5 of metal of a substantially U-shaped cross-section with a base 50 and two side arms 51, 52 which each have through openings 53, 54 for the threaded spindle 100. From the two arms 51, 52 of the holder between which the housing 3, 4 is housed so that a bearing plate 33, 34 is opposite each arm (with the interposition of the arms 411, 412; 421, 422 of the U-shaped housing plates 41, 42) protrudes a fixing flange 55, 56 with a fixing point in the form of a fixing opening 57 and 58 respectively which enables the holder 5 to be fixed on a guide rail of a motor vehicle seat.

As a result of the stable construction of the adjustable mechanism 1, 2 and the associated gearbox housing 3, 4 as well as as a result of the stable hold of the adjustable mechanism 1, 2 and gearbox housing 3, 4 by means of the arms 51, 52 of the U-shaped holder 5 a particularly high resistance of the overall arrangement to external forces, more particularly in a crash situation is reached despite the lightweight and compact structural design of the adjustable mechanism 1,2 and the gearbox housing 3,4. In a crash situation, more particularly a front or rear crash of the corresponding vehicle it must be ensured that the spindle nut 1 does not slip through along the longitudinal direction of the threaded spindle 100, for this would lead to a corresponding acceleration of the associated vehicle seat with an increased risk of injury to the seat occupant. To this end, the spindle nut 1 is held stable between the bearing plates 31, 32 and the arms 51, 52 of the U-shaped holder 5 and in a crash situation is reliably supported in the axial direction a so that it cannot slip in the direction of the longitudinal axis L along the spindle 100.

In order to manufacture the adjustable mechanism 1, 2 shown in Figures 1a to 3 with the gearbox housing 3, 4 a multi component injection moulding process is preferably used whereby all the method steps are preferably carried out in a single injection moulding

tool. First the spindle nut 1 is injected in any tool and then the two bearing plates 31, 32 are injected in the same tool. During injection moulding the spindle nut 1 is hereby mounted in the two bearing plates 31, 32 so that no subsequent assembling of the bearing plates 31, 52 and the spindle nut 1 is required.

The drive worm 2 is then fitted into the injection moulding tool and the outer U-shaped housing plates 41, 42 are injected whereby (as a result of the bearing plates 31, 32 and drive worm 2 located in the injection moulding tool) already during injection moulding the connection is made with the bearing plates 31, 32 in the recesses 45 and the bearing of the drive worm 2 in the associated bearing openings 46. The complete finished gearbox housing 3, 4 can then with the adjustable mechanism 1, 2 mounted therein be removed from the injection moulding tool.

With the method steps described here it is possible to change the sequence of the process stages – depending on the design of the adjustable mechanism and the gearbox housing in individual cases –. Also the installation of the drive worm 2 can also take place only at a later date by clipping into the gearbox housing 3, 4.

Within the scope of a multi component injection moulding process different plastics can thereby be used for spindle nut 1, the bearing plates 31, 32 and the outer U-shaped housing plates 41, 42 .

According to another manufacturing method the bearing plates 31, 32 and the outer U-shaped housing plates 41, 42 are made as individual parts separately from plastics (injection moulded), fitted together at their push-fit connections 35, 45 and then in the region of the push-fit connections are fixed against one another through reshaping or thermal processes such as e.g. laser welding, hot caulking, ultrasound welding or in some other way, e.g. through adhesive.

In each case the connection of the individual housing parts 31, 32; 41, 42 (thus the bearing plates 31, 32 with the outer U-shaped housing plates 41, 42) takes place solely at the push-fit connections 35, 45 by means of which the position of the housing parts 31, 32; 41, 42 relative to each other along all spatial directions is fixed. As connecting points between the housing parts 31, 32; 41, 42 serve preferably only the push-fit connections 35, 45 which are made and fixed either directly during injection moulding of all the housing parts in one injection moulding tool or in the case of separate injection moulding

of the individual housing parts are made subsequently by fitting together and then fixed against one another in an additional connecting step.

Laser welding is particularly suitable as the additional connecting step for connecting the outer U-shaped housing plates 41, 42 with the bearing plates 31, 32 in the region of the push fit connections 35, 45. For this the outer U-shaped housing plates 41, 42 preferably consist of a transparent material for the laser beam used whilst the inner bearing plates 31, 32 absorb the corresponding laser beam and thereby fuse so that a connection is made between the inner bearing plates 31, 32 and the outer U-shaped housing plates 41, 42 in the region of the push fit connections. The desired absorption of the laser beam through the inner bearing plates 31, 32 can be achieved by adding carbon black to the material of these bearing plates.

Before or during the welding of the housing plates 31, 32; 41, 42 of the gearbox housing 3, 4 it is still possible to eliminate axial bearing play between the bearing plates 31, 32 and the spindle nut 1 by applying a defined axial force to the bearing plates 31, 32 before the welding process is completed.

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PATENT CLAIMS

1. Adjustable mechanism for a motor vehicle for adjusting an adjustable part in a motor vehicle, more particularly a seat part, with a spindle nut defining an axis and interacting on the one hand with a threaded spindle and on the other hand having in an external surface an external toothing through which it engages with a further gearing element,

characterised in that

the external toothing (15) of the spindle nut (1) extends in the axial direction (a) only over a part of the axial extension of the outer surface (10) of the spindle nut (1) and is formed through radially inwardly pointing indentations in the external surface (10) of the spindle nut (1), so that the spindle nut (1) has in the axial direction (a) beyond the external toothing (15) at least one end section (11, 12) with a defined diameter and without external toothing.

2. Adjustable mechanism according to claim 1, **characterised in that** the spindle nut (1) has in the axial direction (a) on either side of the external toothing (15) an end section (11, 12) each with a defined diameter and in that the external toothing (15) is formed by indentations in the external surface (10) of the spindle nut (1) in relation to the two end sections (11, 12).

3. Adjustable mechanism according to claim 1 or 2, **characterised in that** the spindle nut (1) has an external surface (10) in the form of a cylinder sleeve and in that the external toothing (15) is formed by indentations of the external surface (10), wherein the diameter of the at least one end section (11, 12) is preferably larger than or equal to the diameter of the external surface (10).

4. Adjustable mechanism according to claim 2 to 3, **characterised in that** the spindle nut (1) in the region of the external toothing (15) does not project in the radial direction (r) beyond the end sections (11, 12).

5. Adjustable mechanism according to one of the preceding claims, **characterised in that** the external toothing (15) is globoid in shape and more particularly has globoid toothing in its axial edge regions (17, 18).

6. Adjustable mechanism according to one of the preceding claims, **characterised in that** the external toothing (15) has an involute profile in a middle section (16) in the axial direction (a).

7. Adjustable mechanism according to one of the preceding claims, **characterised in that** the spindle nut (1) is made of plastics.

8. Adjustable mechanism according to one of the preceding claims, **characterised in that** the spindle nut (1) interacts, through its external toothing (15), with a worm as a further gearing element (2).

9. Adjustable mechanism according to one of the preceding claims, **characterised in that** the internal toothing (19) of the spindle nut (1) associated with the spindle (100) extends in the axial direction (a) over a greater length that the external toothing (15) so that the internal toothing (19) extends axially up into at least one end section (11, 12).

10. Adjustable mechanism according to one of the preceding claims, **characterised in that** the tooth thickness (d) of the internal toothing (19) of the spindle nut (1) interacting with the threaded spindle (100) is greater than its gap width (e).

11. Adjustable mechanism according to one of the preceding claims, **characterised in that** the spindle nut (1) and the further gearing element (2) are mounted in a gearbox housing (3,4).

12. Adjustable mechanism according to claim 11, **characterised in that** the gearbox housing (3, 4) is formed by housing plates (31, 32; 41, 42).

13. Adjustable mechanism according to claim 12, **characterised in that** the housing parts (31, 32; 41, 42) are connected to one another through push-fit connections (35, 45) and are aligned relative to each other along all spatial directions.

14. Adjustable mechanism according to claim 12 or 13, **characterised in that** the gearbox housing (3, 4) consists of one or two pairs of opposing housing parts (31, 32; 41, 42).

15. Adjustable mechanism according to one of claims 12 to 13, **characterised in that** the gearbox housing (3, 4) comprises two external housing parts (41, 42) which have a U-shaped cross-section.

16. Adjustable mechanism according to claim 15, **characterised in that** the outer housing parts (41, 42) engage round bearing parts (31, 32) mounted opposite one another in the axial direction (a) to support the spindle nut (1).

17. Adjustable mechanism according to claim 16, **characterised in that** the outer housing parts (41, 42) surround bearing sections (33, 34) of the bearing parts (31, 32).

18. Adjustable mechanism according to one of claims 11 to 17, **characterised in that** the gearbox housing (3, 4) is of plastics.

19. Adjustable mechanism according to one of claims 11 to 18, **characterised in that** the gearbox housing has bearing points (33, 34; 46) in particular in the form of bearing openings for the spindle nut (1) and/or the further gearing element (2).

20. Adjustable mechanism according to one of the preceding claims, **characterised in that** in each case a bearing collar (13, 14) for supporting the spindle nut (1) protrudes from the axial end sections (11, 12) of the spindle nut (1).

21. Adjustable mechanism according to claim 2 or one of claims 3 to 19 if referring back to claim 2, **characterised in that** the end sections (11, 12) serve at the same time as bearings for supporting the spindle nut (1), wherein the axial and radial bearing is produced through a pair of housing parts (41, 42) of a gearbox housing.

22. Adjustable mechanism according to one of claims 11 to 21, **characterised in that** the gearbox housing (3, 4) has in at least one boundary wall a recess (48, 49) in which the spindle nut (1) and/or further gearing element (2) radially engages.

23. Adjustable mechanism according to claim 22, **characterised in that** the recess (48, 49) is formed through an opening in the relevant boundary wall.

24. Adjustable mechanism according to claim 22, **characterised in that** the recess is formed through an indentation in the relevant boundary wall.

25. Adjustable mechanism according to one of claims 22 to 24, **characterised in that** in the gearing housing (3, 4) are formed two recesses (46), arranged opposite one another across the axis (L) of the spindle nut (1), for the spindle nut (1).

26. Adjustable mechanism according to one of claims 22 to 25, **characterised in that** in a boundary wall of the gearbox housing (3, 4) a recess (49) is formed for the side of the further gearing element (2) in each case remote from the spindle nut (1).

27. Adjustable mechanism according to one of claims 11 to 26, **characterised in that** between the gearbox housing (3, 4) and an associated holder (5) of the gearbox housing (3, 4) there is at least one element for acoustic uncoupling which is formed preferably as a resilient element.

28. Adjustable mechanism according to claim 27, **characterised in that** the elastic elements are moulded, more particularly injected, in one piece on the gearbox housing.

29. Adjustable mechanism according to one of claims 11 to 28, **characterised in that** the spindle nut (1) is mounted without a spacer disc or by means of a spacer disc made of steel in the gearbox housing (3, 4).

30. Adjustable mechanism according to one of claims 11 to 29, **characterised in that** the housing parts (31, 32; 41, 42) are connected to one another through laser welding.

31. Adjustable mechanism according to claim 30, **characterised in that** the gearbox housing (3, 4) has internal housing parts (31, 32) and external housing parts (41, 42), wherein the material of the outer housing parts (41, 42) is designed transparent for the laser beam used for welding, and the material of the inner housing parts (31, 32) is designed non-transparent for the laser beam used so that a connection with the outer housing parts (41, 42) can be produced through partial melting of the inner housing parts (31, 32).

32. Adjustable mechanism according to claims 7, 16 and 18, **characterised in that** at least the spindle nut (1) and the bearing plates (31, 32) of the gearbox housing (3, 4) are made together in one injection moulding tool.

33. Adjustable mechanism according to one of the preceding claims, **characterised in that** the gearbox housing (3, 4) is set in a holder (5) of U-shaped cross-section, by means of which it can be fixed against an associated adjustable part.

34. Method for manufacturing an adjustable mechanism with the features of claims 1, 7, 16 and 18,

characterised in that

the spindle nut (1) and the bearing parts (31, 32) are made together in one injection moulding tool in a multi-stage injection moulding process.

35. Method according to claim 34, **characterised in that** the spindle nut (1) and the bearing parts (31, 32) are made in the injection moulding tool one after the other through injection moulding, wherein the structural assembly unit each previously made remains in the injection moulding tool whilst the next assembly unit to be made is injected.

36. Method according to claim 34 or 35, **characterised in that** further parts of the gearbox housing (3, 4) are made in the injection moulding tool whilst the previously made structural assemblies (1, 31, 32) remain in the injection moulding tool.

37. Method according to one of claims 3 to 36, **characterised in that** outer U-shaped housing parts (41, 42) of the gearbox housing (3, 4) are made in the injection moulding tool.

38. Method according to one of claims 34 to 37, **characterised in that** the further gear element (2) is inserted in the injection moulding tool before the parts (41, 42) of the gearbox housing (3, 4) which are provided for supporting the further gear element (2) are made by injection moulding.

39. Method according to one of claims 34 to 38 for manufacturing an adjustable mechanism with the features of claim 30, **characterised in that** before or during the connection of the housing parts (31, 32; 41, 42) by laser welding any axial bearing play between the inner housing parts (31, 32) of the gearbox housing (3, 4) and the spindle nut (1) is removed.

40. Method according to claim 39, **characterised in that** the axial bearing play is removed by

a) applying a defined axial force to the inner housing parts (31, 32),

b) melting regions of the inner housing parts (31, 32) which are enclosed by the push-in areas (45) of the outer housing parts (41, 42) and

c) terminating the laser welding when the at least one end section (11, 12) of the spindle nut (1) bears against the gearbox housing (3, 4).

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Summary

The invention relates to an adjustable mechanism for a motor vehicle for adjusting an adjustable part in a motor vehicle, more particularly a seat part, with a spindle nut defining an axis and interacting on the one side with a threaded spindle and on the other side having in an external surface an external toothing through which it engages with a further gearing element. According to the invention it is provided that the external toothing (15) of the spindle nut (1) extends in the axial direction (a) only over a part of the axial extension of the outer surface (10) of the spindle nut (1) and is formed through radially inwardly pointing indentations in the external surface (10) of the spindle nut (1), so that the spindle nut (1) has in the axial direction (a) beyond the external toothing (15) at least one end section (11, 12) with a defined diameter and without external toothing.

Figure 1a

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